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(54) Aluminium vehicle door frame structure

(57) A vehicle door frame structure 12 comprises a number of aluminium extrusions 14, 16, 34, 38, 40 and a number of cast aluminium nodes 18, 36, 41a, 41b, 41c. The nodes 36, 41b at the front of the door have holes 71, 73, bolts through which support the door hinges. The casting 18, 32 at the rear extends from the waistrail 30 down to the bottom of the door and includes a housing for the door latch and lock mechanism. The extrusions may include internal deformable projections to provide a secure fit with inserted nodes.

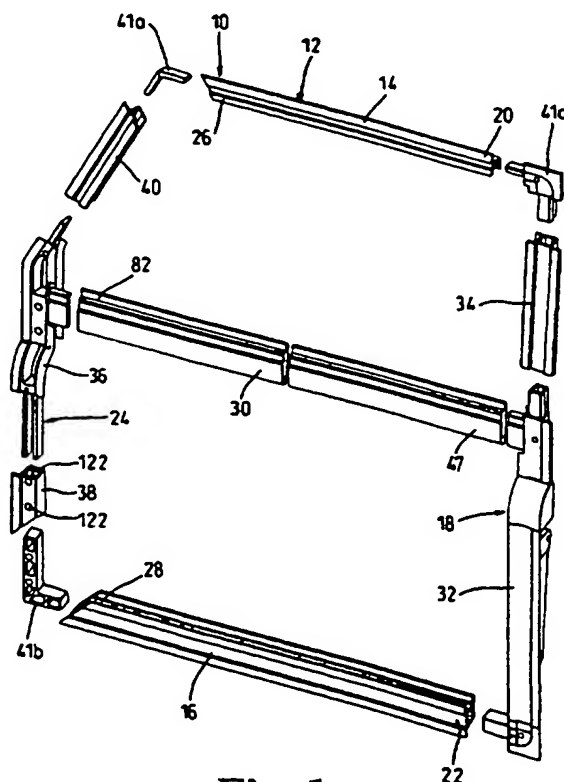


Fig. 1

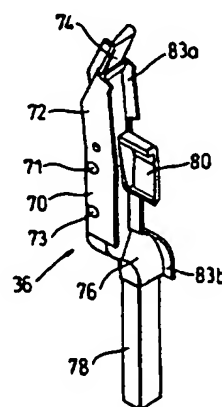


Fig. 5

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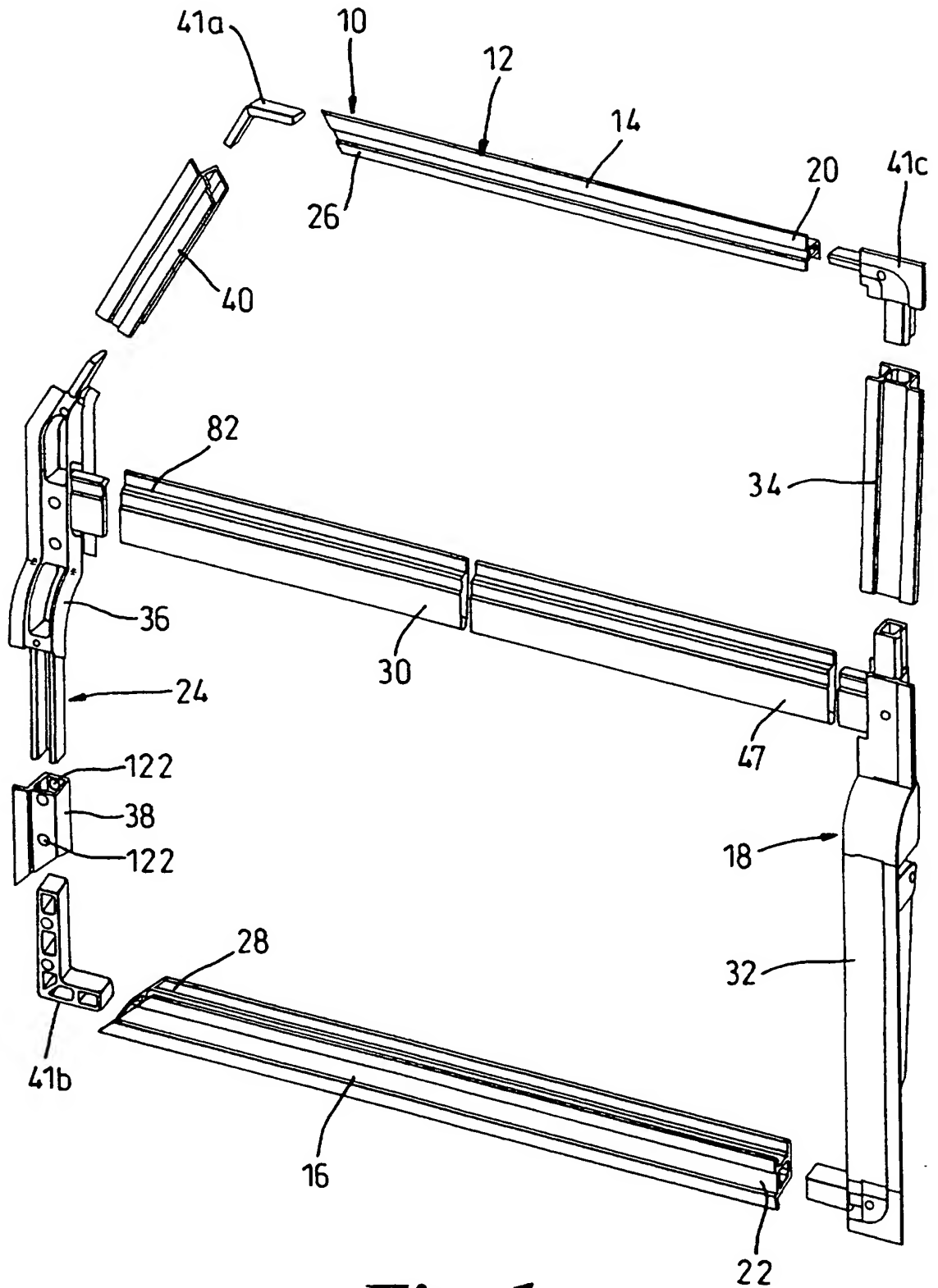


Fig. 1

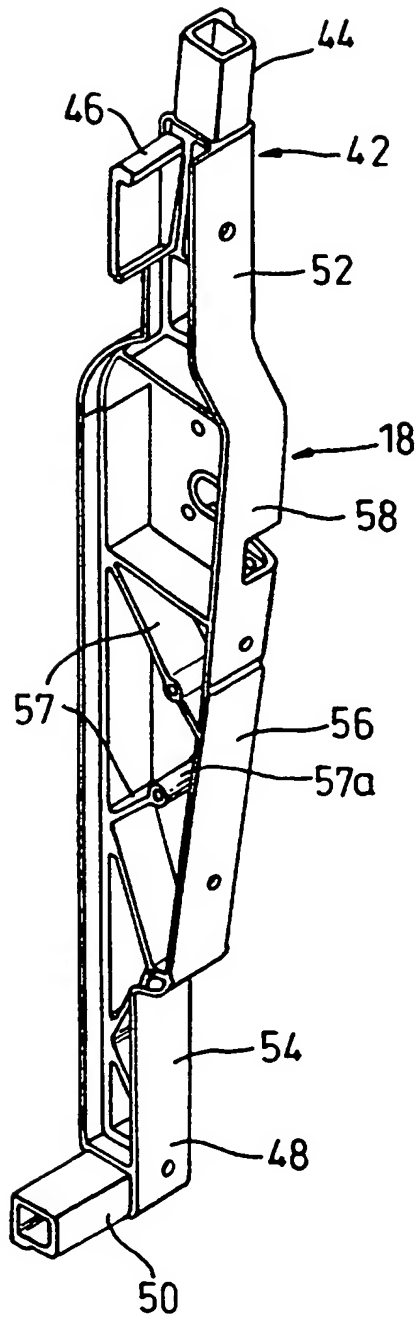


Fig. 2

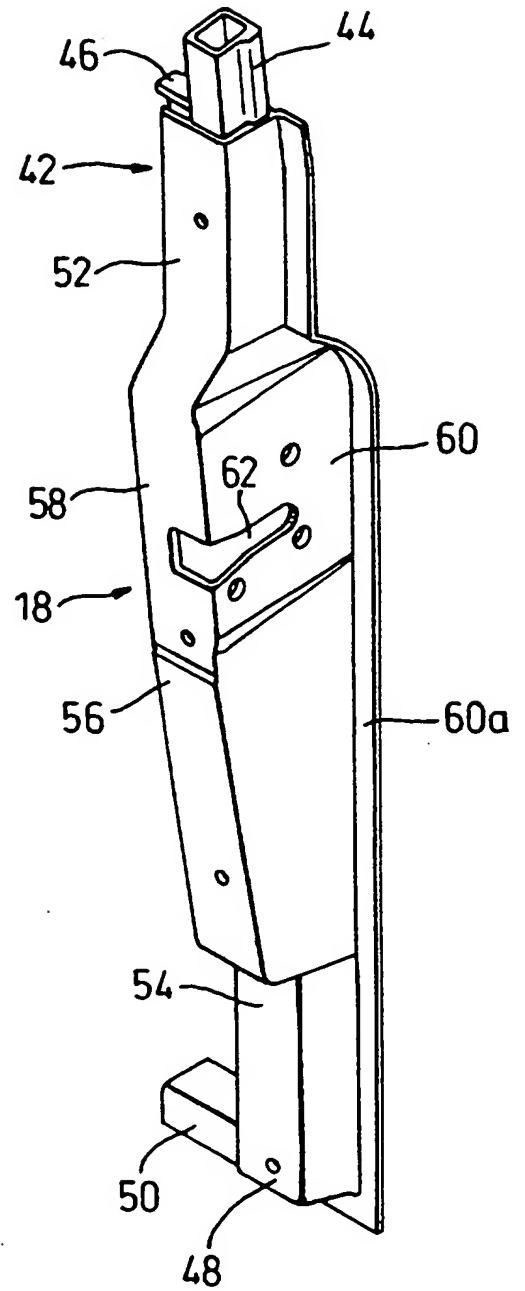


Fig. 3

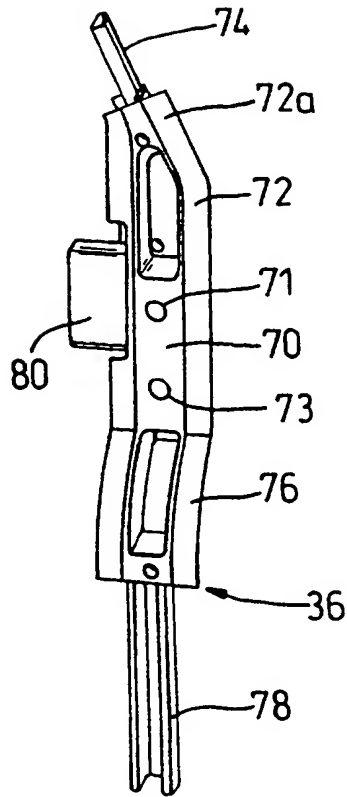


Fig. 4

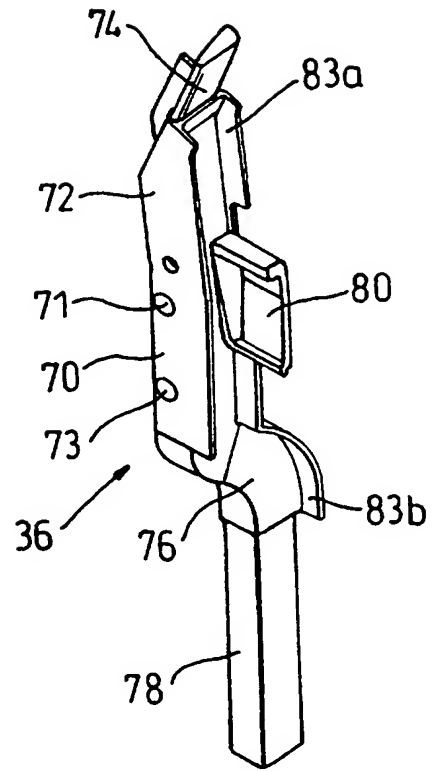


Fig. 5

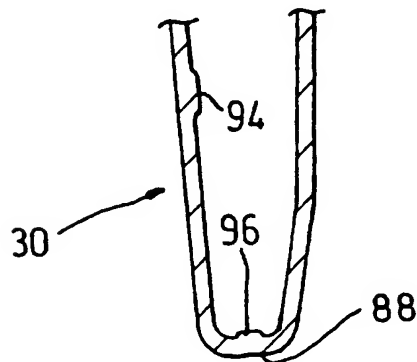
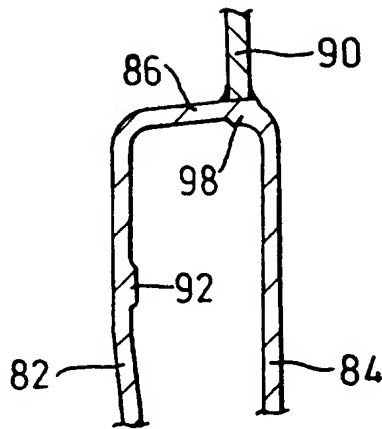


Fig. 6

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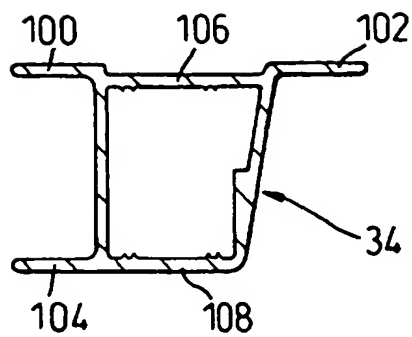


Fig. 7

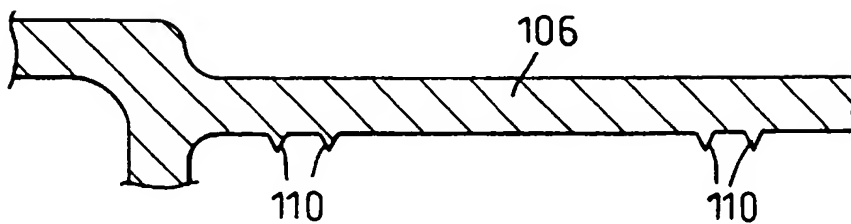


Fig. 8

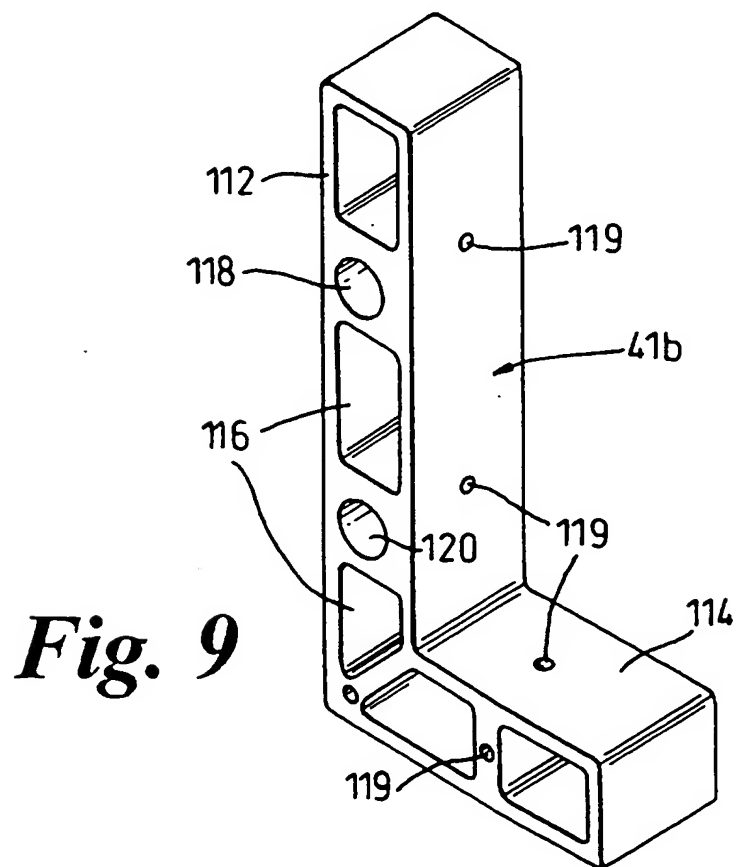


Fig. 9

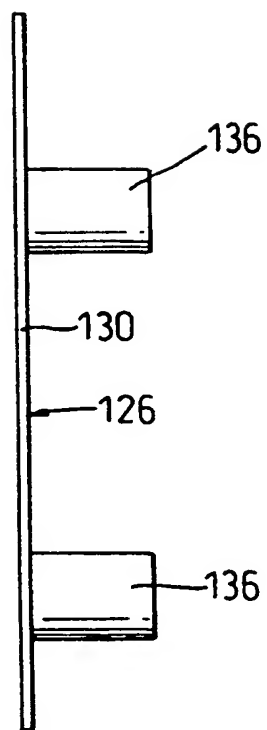


Fig. 10

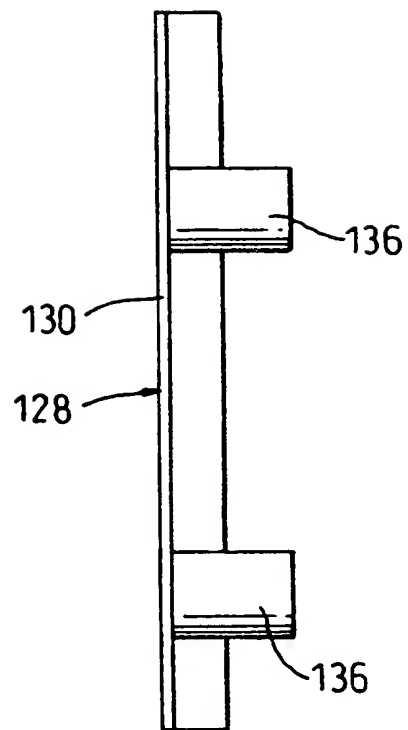


Fig. 12

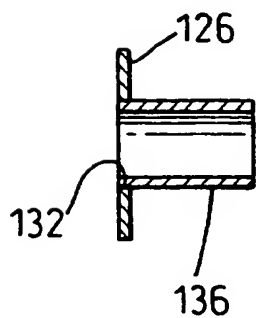


Fig. 11

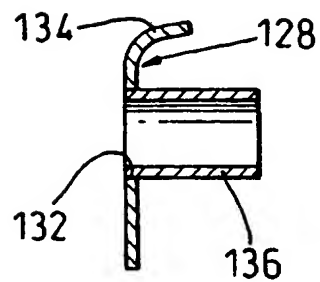


Fig. 13

Vehicle Door Structures

The present invention relates to vehicle door structures.

It is becoming increasingly popular to construct vehicle bodies from aluminium rather than steel. This gives
5 rise to a need to completely re-design most parts of the vehicle body because of the difference in physical properties between aluminium and steel. It is known, for example from US 5 375 314 to construct vehicle bodies using aluminium extrusions joined by cast aluminium joints known
10 as nodes.

The present invention provides a vehicle door structure including an aluminium frame comprising a top section extending along the top of the door, a bottom section extending along the bottom of the door, a hinged end
15 section joining the top and bottom sections at one end thereof, and a free end section joining the top and bottom sections at the other end thereof, and a waistrail joined at each end to a respective one of the end sections, wherein one of the end sections includes a cast node to
20 which the waistrail is attached.

Generally the hinged end of the door will be the front, and the free end will be the rear.

The present invention also provides a vehicle door structure comprising a plurality of aluminium extrusions

joined by at least one node member, the node member including mounting means for mounting the door on a hinge.

Preferred embodiments of the present invention will now be described by way of example only with reference to the
5 accompanying drawings in which:

Fig. 1 is an expanded view of a door structure according to the invention;

Figs. 2 and 3 are perspective views of a casting forming part of the structure of Fig. 1;

10 Figs. 4 and 5 are perspective views of another casting forming part of the structure of Fig. 1;

Figs. 6 and 7 are a sections through respective extrusions forming part of the structure of Fig. 1;

Fig. 8 is an enlargement of part of Figure 7; and

15 Fig. 9 is a perspective view of a node forming part of the structure of Fig. 1.

Referring to Figure 1, a vehicle door 10 includes a frame 12 comprising top and bottom sections 14, 16 which extend, in use, horizontally along the top and bottom edges
20 of the door 10, a rear end section 18 extending vertically between the rear ends 20, 22 of the top and bottom sections 14, 16, a front end section 24 extending between the front

ends 26, 28 of the top and bottom sections 14, 16, and a
waistrail 30 extending horizontally between the end
sections 18, 24.

The top and bottom sections 14, 16 and the waistrail 30
5 each comprise a single hollow aluminium extrusion. The rear
end section 18 comprises a front end casting 32 and a
vertical upper part formed as a single hollow upper rear
extrusion 34. The front end section 24 comprises a front
end casting 36, a vertical lower part formed as a single
10 hollow lower front extrusion 38, and an upper part formed
as a single hollow upper front extrusion 40. Aluminium
nodes 41a, 41b, 41c provide the joints between the
extrusions at the top and bottom front corners and top rear
corner of the door.

15 Referring to Figures 2 and 3, the rear end casting 18
has at its upper end 42 an upwardly extending projection
44, which is inclined towards the centre line of the
vehicle, onto which the upper rear extrusion 34 fits, and a
horizontally extending projection 46 onto which the rear
20 end 47 of the waistrail 30 fits. At its lower end 48 it has
another horizontally extending projection 50 onto which the
extruded bottom section 16 fits. The projections 44 and 50
are hollow to save weight. At each of the upper and lower
ends 42, 48 the casting 18 comprises a relatively narrow
25 end section 52, 54. Between these the casting widens out
into a wider central section 56, the upper part of which
forms a housing 58 for a door latch mechanism, and the

lower part of which has internal webs 57 in to provide adequate stiffness. These webs 57 have hollow cylindrical forms 57a integrated into them to accept fixings to attach a bracket (not shown) to the door. The rear face 60 of the housing 58 forms a visible part of the door structure when the door is open. It has an aperture 62 through it for receiving a latch component in the form of a steel hoop mounted on the door aperture of the vehicle body such that it can engage with the latch mechanism housed within the casting 18. It also has a flange 60a around its outer edge which sets up the styled surface of the door and permits clinching of the door skin to this part of the door frame.

Referring to Figures 4 and 5 the front end casting 36 comprises a central hinge mounting section 70, with an upper support section 72 above it which has an upper projection 74 on its upper end 72a. The upper projection 74 projects upwards, but also backwards and inwards, at an angle to the vertical. The front upper extrusion 40 fits onto the projection 74. The casting 36 further comprises a lower support portion 76 extending downwards and outwards from the central section 70, which has a lower projection 78 extending vertically downwards from its lower end, onto which the lower front extrusion 38 fits. The lower projection 78 also extends downwards far enough to reinforce the lower front extrusion 38 at the point where the check stop (not shown), which limits the opening of the door, is mounted on the door. A horizontal projection 80

extends rearwards from the central section 70, and is arranged so that the front end 82 of the waistrail extrusion 30 can fit onto it. The hinge mounting section 70 has a pair of bolt holes 71, 73 for receiving bolts by means of which the door is secured to an upper hinge (not shown). Flanges 83a, 83b around the edges of the hinge mounting section 70 and the upper and lower support sections 72, 76 set up the styled surface of the door and permit clinching of the door skins to this part of the door frame.

The shape of the lower support section 76 allows the upper and lower projections 74, 78, and therefore the upper and lower front extrusions 40, 38, to be in different vertical planes thereby offsetting one from the other. This is necessary so that the door glass (not shown) which is supported in the upper front extrusion 40 when in a closed position, can drop down inside the lower part of the door structure when the window is opened.

Referring to Figure 6, the waistrail extrusion 30 is of a narrow hollow section, having relatively long vertical sides 82, 84 and narrow top 86 and bottom 88. A flange 90, which provides a mounting for the external glass seal, extends vertically upwards from the top 86. A pair of low ridges 92, 94 run along the inside of one of the vertical sides 82. Another one 96 runs along the inside of the bottom 88. A fourth ridge 98 runs along the inside of the top 86 in the corner where it joins the side 84. The ridges

92, 94, 96, 98 extend along the full length of the extrusion 30 and are formed by the extrusion process. When the waistrail 30 is fitted onto the projections 46, 80 on the castings 18 36, these ridges 92, 94, 96, 98 provide a
5 glue gap between the inside of the waistrail 30 and the projections 46, 80 which ensures that sufficient glue remains in the joint to provide a secure fixing.

Referring to Figures 7 and 8, the upper rear extrusion 34 is of a substantially square hollow section with flanges
10 100, 102, 104 protruding from it, two of which 102, 104 are arranged for clinching to the door skins. On each of two opposite sides 106, 108 of the hollow section, on the inside surface, are two spaced apart pairs of narrow ridges 110 of triangular cross section, about 0.5 mm in height.
15 These ridges, which are shown in detail in Figure 8, are deformable when the extrusion 34 is fitted onto the casting 18 and the node 41c, and ensure a tight and secure fit. They also ensure that, on each of the two sides 106, 108, there is a glue gap between the extrusion and the node
20 which will allow enough glue to remain in place to form a good bond, and that glue will be retained in a bonding area on each of the two sides 106, 108, between the pairs of ridges.

Referring to Figure 9, the node 41b at the bottom front
25 corner of the door comprises a short length cut from an extrusion of L-shaped cross section, and therefore comprises a long limb 112 and a short limb 114 at right

angles to each other. The longer limb 114 is vertical and the bottom end of the lower front extrusion 38 fits over it. The shorter limb 114 is horizontal and the front end of the bottom extrusion 16 fits over it. Five cavities 116
5 extend through the node 41c in the direction in which it was extruded, and between these, and parallel to them, in the vertical limb 114, extend two parallel bolt holes 118, 120 of circular cross section. These are arranged to receive bolts securing the door onto a lower hinge (not
10 shown). The lower end of the lower front extrusion 38 has holes 122 (see Fig. 1) through it which are aligned with the bolt holes 116 118 in the node 41b so that the bolts pass through them also when in place. The bottom extrusion 16 and lower front extrusion 38 fit right over the node 41b
15 so that they meet, masking it from view.

The node 41a is bonded to the extrusions 16, 38 by adhesive after they have been pushed over it. The adhesive is injected through a single injection hole in each extrusion 16, 38 and a series of cross drillings 119 are
20 provided in the extruded node 41b which allow the adhesive to flow around the node and produce a good bond.

In order to strengthen the hinge mountings for the door, each pair of hinge bolt holes 71, 73 and 118, 120 122 is supported by a pair of steel reinforcing members 126, 128, a first of which is shown in Figures 10 and 11, and a
25 second of which is shown in Figures 12 and 13. Each reinforcing member comprises a flat plate 130 having a pair

of circular holes 132 through it. For each hole 132 in each plate, a short tube 136 of circular cross section is welded onto the plate such that one end fits into the hole 132. The plate 130 of the second reinforcing member has a curved
5 edge portion 134 which fits around the aluminium structure. One pair reinforcing members 126, 128 are placed on opposite sides of the mounting portion 70 of the casting 36 with the tubes 136 extending into the bolt holes 71, 73, and another pair are placed on opposite sides of the lower
10 front extrusion 38 to reinforce the mounting holes 118, 120, 122. The reinforcing members 126, 128 are bonded to the door frame by adhesive which forms a layer between the respective mounting member and the node 36, 41b. This layer transmits forces between the reinforcing members and the
15 nodes by means of shear stresses in the adhesive layers, which avoids excessive bearing stresses which could otherwise occur.

The door structure described above has the advantages that it is relatively stiff due to the fact that the
20 castings 36, 18 extend vertically over a substantial part of the height of the door. It is also very rigidly mounted because both of the hinge mountings extend through the aluminium nodes 36, 41b of the door structure.

CLAIMS

1. A vehicle door structure including an aluminium frame comprising a top section extending along the top of the door, a bottom section extending along the bottom of the door, a hinged end section joining the top and bottom sections at one end thereof, and a free end section joining the top and bottom sections at the other end thereof, and a waistrail joined at each end to a respective one of the end sections, wherein one of the end sections includes a cast node to which the waistrail is attached.
2. A door structure according to claim 1 wherein said end section includes an upper part extending between said node and the upper section.
3. A door structure according to claim 1 or claim 2 wherein said end section includes a lower part extending between said node and the lower section.
4. A door structure according to claim 3 when dependent on claim 2 wherein said upper and lower parts are in different planes offset from one another.
5. A door structure according to claim 4 wherein the node includes connecting portions for each of said parts, each of which projects in a direction substantially within the respective plane.

6. A door structure according to claim 1 or claim 2 wherein said node extends vertically downwards to the bottom section and is joined to it.
7. A door structure according to claim 6 wherein the node includes a horizontally projecting connecting portion for connecting with the bottom section.
8. A door structure according to any foregoing claim wherein said end section is at a free end of the door structure and the node includes a housing portion for housing a door securing mechanism.
9. A door structure according to any foregoing claim wherein the node includes at least one flange arranged for attaching a door skin to.
10. A door structure according to any one of claims 1 to 9 wherein said end section is at a hinged end of the door structure and includes a hinge mounting portion by means of which the door structure can be mounted on a hinge.
11. A vehicle door structure comprising a plurality of aluminium extrusions joined by at least one node member, the node member including mounting means for mounting the door on a hinge.
12. A vehicle door structure according to claim 11 wherein the mounting means comprises a portion of the node

element having a hole through it for receiving a securing member for securing the door structure to the hinge.

13. A vehicle door structure according to claim 12 wherein one of the extrusions has a hole through it which is aligned with that in the node element such that the securing member can pass through both said holes.
14. A structure according to claim 12 or claim 13 further including reinforcing means arranged to reinforce the door structure in the region around said hole or holes.
15. A structure according to claim 14 wherein the reinforcing means comprises a plate portion and a tubular portion which extends into said hole.
16. A structure according to claim 14 or claim 15 wherein the reinforcing means is bonded to at least one of the node and the extrusion by an adhesive.
17. A structure according to claim 16 wherein the adhesive is in the form of an adhesive layer arranged so that loads transmitted between the reinforcing means and the node can be reacted via shear stresses in the adhesive layer.
18. A vehicle door structure substantially as hereinbefore described with reference to the accompanying drawings.



Application No: GB 9716141.8
Claims searched: 1-18

Examiner: John Rowlatt
Date of search: 4 November 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): EIJ: JGA, JGS.

Int Cl (Ed.6): B60J, B60S, B62D, E06B.

Other: Online: World Patents Index, EDOC, JAPIO.

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB2275290A (JENBACHER TRANSPORTSYSTEME AG)	
A	US5375314A (BORA) Equivalents include EP0591227A1 & WO93/00245A1	
A	DE3738358A (NEHER)	

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